

REMARKS

Claims 1 -14 were pending. Claim 14, which was withdrawn from consideration, has been canceled without prejudice or disclaimer, and new claims 15-21 have been added. Reexamination and reconsideration of the present application is respectfully requested.

At the outset, the Examiner is thanked for the thorough review and consideration of the present application. The Examiner's Office Action dated June 6, 2003 has been received and the contents carefully noted.

In the Office Action, the Examiner objected to the drawings for failing to comply with 37 CFR 1.84(p)(5) because they include reference signs not mentioned in the description. Also, the Examiner stated that Figure 14 should be designated by a legend such as --Prior Art-- as per MPEP 608.02(g).

Regarding the objection, the specification has been amended to include the reference signs "L," "t," and "W" shown in Figures 2(a)-2(c) and 14(a)-14(c). The legend "Prior Art" has been added to Figures 14(a)-14(c) in the attached replacement sheet. Applicants respectfully request that the objections to the drawings be withdrawn.

The Examiner objected to claim 8 because of informalities such as punctuation. Regarding the objection to claim 8, the second period at the end of claim 8 has been deleted. Applicants respectfully request that the objection to claim 8 be withdrawn.

The Examiner rejected claims 1, 2, 6, 8, and 9 under 35 USC 102(b) as being anticipated by Pfeil (US Patent No. 2,406,966). The rejection is respectfully traversed.

Claim 1, as amended, is allowable at least for the reason that claim 1 recites a combination of features, including,

"...a center electrode retained in said metal shell and insulated from said metal shell, said center electrode having a body portion made of a first material and a tip portion made of a second material different from the first material,

wherein the tip portion is connected to an end of the body portion by a welding material; and
..., said ground electrode being joined to said metal shell through a weld fused by one of a laser welding material and an arc welding material." [emphasis added]

Claim 8, as amended, is allowable at least for the reason that claim 8 recites a combination of features, including,

"...a center electrode retained in said metal shell and insulated from said metal shell, said center electrode having a body portion made of a first material and a tip portion made of a second material different from the first material, wherein the tip portion is connected to an end of the body portion by a welding material; and
..., said ground electrode being all made of an Ir alloy including a main component of 50 Wt% or more of Ir and joined directly to said metal shell." [emphasis added]

None of the cited references teaches or suggests each and every element of the claims.

In the present invention, a spark plug has a ground electrode opposed to a center electrode to define a spark gap therebetween. The ground electrode is made of a noble metal such as an Ir alloy for increasing the heat and wear resistance and is joined directly to a metal shell of the spark plug by laser or arc welding. *See Abstract.* Specifically, the joint of the ground electrode 12 and the metal shell 10 provided by the laser welding is formed by a series of fused portions 45, as clearly shown in FIG. 2(b), in which materials of the ground electrode 40 and the metal shell 10 are melted together by a sequence of laser radiations, while the joint provided by the arc welding is formed by a single fused portion 45, as clearly shown in FIG. 3(b), in which the materials of the ground electrode 40 and the metal shell 10 are melted together by an electric arc radiated to the whole of a desired welding area. *See specification page 11, lines 11-19.*

Pfeil discloses a spark plug having a center electrode with two portions 1 and 5 and a ground electrode 8 spot-welded at 9 to a plug nose 10. *See* column 3, lines 54-68. A piece of silver or copper wire is dropped into a hole in the insulator 3 and the whole assembly is passed through a furnace to melt the silver or copper wire and cause it to fuse around the wire 1 as shown at 4 and subsequently to solidify in position. *See* column 3, lines 1-45.

In the present invention, center electrode 30 includes two portions, body portion 32 and tip portion 31 welded to body portion 32. The ground electrode 40 is welded to the shell 10 by laser welding or arc welding. The laser and arc welding does not involve a pressing operation as required in the resistance welding, thus allowing the spark gap 50 to be adjusted easily during the welding using a spacer without applying an unwanted load on the Ir alloy and its weld. This eliminates the need for a gap adjustment process after the welding which is essential to the conventional spark plugs. *See* specification at page 16, line 12.

In contrast, the center electrode in Pfeil has two portions 1 and 5 that appear to be separated from one another and made of the same material, and the ground electrode 8 is spot-welded to the nose 10. Therefore, the use of the techniques (resistance welding) taught in Pfeil results in shrinkage of the earth electrode at the weld, thus requiring a gap adjustment. Pfeil therefore fails to teach a center electrode having a body portion made of a first material and a tip portion made of a second material different from the first material as recited in claims 1 and 8. Further, a tip portion in Pfeil is not connected to an end of a body portion by a welding material as recited in claims 1 and 8. In addition, in Pfeil the ground electrode is not joined to the metal shell through a weld fused by one of a laser welding material and an arc welding material as recited in claim 1. Also, Pfeil fails to

discuss a ground electrode made of an Ir alloy including a main component of 50 Wt% or more of Ir and joined directly to said metal shell as recited in claim 8.

It can thus be understood that the cited reference does not in any way anticipate the essential features of the present invention as set out in independent claims 1 and 8.

Moreover, as claims 2, 6, and 9 each depend from one of independent claims 1 and 8, each of these claims is also allowable for the same reasons as their respective base claim.

As the cited reference fails to anticipate the present invention as recited in independent claims 1 and 8, Applicants respectfully request that the rejection of claims 1, 2, 6, 8, and 9 under 35 USC 102(b) be withdrawn.

The Examiner rejected claims 3 and 10 under 35 USC 103(a) as being unpatentable over Pfeil. This rejection is respectfully traversed.

Claims 3 and 10 recite features regarding the depth of the weld. The cited reference neither teaches nor suggests at least these features of the claimed invention.

As discussed above, Pfeil fails to discuss the features of independent claims 1 and 8, upon which claims 3 and 10 depend, respectively.

As claims 3 and 10 each depend from one of independent claims 1 and 8, each of these claims is also allowable for the same reasons as their respective base claim.

As the cited reference fails to make obvious the present invention as recited in independent claims 1 and 8, Applicants respectfully request that the rejection of claims 3 and 10 under 35 USC 103(a) be withdrawn.

The Examiner rejected claims 4, 5, 11, and 12 under 35 USC 103(a) as being unpatentable over Pfeil as applied to claims 1 and 8 above, and further in view of Takafumi et al. (JP 63-266-46). This rejection is respectfully traversed.

Claims 4, 5, 11, and 12 recite features regarding the metal shell material. In tests conducted by Applicant, it was discovered that in order to ensure a desired reliability level of the joint of the ground electrode 40 to the Fe alloy metal shell 10, the contents of S, Si, C, Mn, and P should contain the claimed ranges discussed in the specification at pages 13-19. None of the cited references teaches or suggests at least these features of the claimed invention.

As discussed above, Pfeil fails to discuss the features of independent claims 1 and 8, upon which claims 4, 5, 11, and 12 depend, respectively. The Examiner cited Takafumi et al. in an attempt to cure the deficiencies of Pfeil.

Takafumi et al. teaches a spark plug made having improved tensile strength and made of steel containing by weight, 0.03-0.20% C, 0.35% Si, 0.1-2.0% Mn, 0.025% P, 0.25% S and 0.005-0.080% Al, and furthermore containing a material selected from the group of 0.005-0.25% Zr, 0.005-0.10% Nb, 0.03-0.25% V, 0.005-0.25% Ti, 0.05-0.50% Cr and 0.05-0.50% Ni and with the balance consisting of Fe with inevitable impurities. Also, Takafumi et al. is merely concerned with the material used for the spark plug housing, but fails to discuss a Fe alloy metal shell having other contents as recited in claims 4, 5, 11, and 12.

Further, the center electrode in Takafumi et al. appears to only have one portion for the center electrode, which appears to be made of one material, and the ground electrode appears to be uniformly joined to the shell. Also, Takafumi et al. fails to teach a center electrode having a body portion made of a first material and a tip portion made of a second material different from the first material as recited in claims 1 and 8. Further, the tip portion in Takafumi et al. is not connected to an end of a body portion by a welding material as recited in claims 1 and 8. Furthermore, in Takafumi et al. the ground electrode

is not joined to the metal shell through a single portion fused by one of a laser welding material and an arc welding material as recited in claims 1 and 8. Also, Takafumi et al. fails to discuss a ground electrode made of an Iridium alloy including a main component of 50 Wt% or more of Iridium and joined directly to said metal shell as recited in claim 8. Thus, Takafumi et al. fails to cure the deficiencies of Pfeil.

It can thus be understood that the combination of references does not in any way make obvious the essential features of the present invention as set out in independent claims 1 and 8.

Moreover, as claims 4, 5, 11, and 12 each depend from one of independent claims 1 and 8, each of these claims is also allowable for the same reasons as their respective base claim.

As the cited references fail to make obvious the present invention as recited in independent claims 1 and 8, Applicants respectfully request that the rejection of claims 4, 5, 11, and 12 under 35 USC 103(a) be withdrawn.

The Examiner rejected claims 2, 6-8, and 13 under 35 USC 103(a) as being unpatentable over Pfeil as applied to claims 1 and 8 above, and further in view of Middleton (US Patent No. 2,476,208). This rejection is respectfully traversed.

Claims 2, 6-8, and 13 recite features regarding the ground electrode material. The ground electrode 40 is made of an Ir alloy, but may alternatively be made of a Pt alloy containing 50 Wt % or more of Pt which is excellent in wear resistance. *See* specification at page 21, line 15. Thus, the breakage of ground electrode of the present invention is avoided due to the strength of the material used. None of the cited references teaches or suggests at least these features of the claimed invention.

As discussed above, Pfeil fails to discuss the features of independent claims 1 and 8, upon which claims 2, 6, 7, and 13 depend, respectively. The Examiner cited Middleton in an attempt to cure the deficiencies of Pfeil.

In the case where a ground electrode is entirely made of Pt, the ground electrode is susceptible to breakage because of the lack of strength of the metal. Middleton teaches a sintered precious metal product having a precious metal content of at least 50%. This reference merely discusses that an electrode of precious metal or precious metal alloy is highly resistant to recrystallization and to the penetration of lead compounds. Middleton fails to disclose a ground electrode made of the material as recited in claims 2, 6-8, and 13.

Middleton fails to teach a center electrode having a body portion made of a first material and a tip portion made of a second material different from the first material as recited in claims 1 and 8. Also, there is no tip portion in Middleton connected to an end of a body portion by a welding material as recited in claims 1 and 8. Further, in Middleton there is no ground electrode joined to the metal shell through a single portion fused by one of a laser welding material and an arc welding material as recited in claim 1. Furthermore, Middleton fails to discuss a ground electrode made of an Iridium alloy including a main component of 50 Wt% or more of Iridium and joined directly to said metal shell as recited in claim 8. Thus, Middleton fails to cure the deficiencies of Pfeil.

It can thus be understood that the combination of references does not in any way make obvious the essential features of the present invention as set out in independent claims 1 and 8.

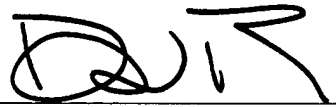
Moreover, as claims 2, 6, 7, and 13 each depend from one of independent claims 1 and 8, each of these claims is also allowable for the same reasons as their respective base claim.

As the cited references fail to make obvious the present invention as recited in independent claims 1 and 8, Applicants respectfully request that the rejection of claims 2, 6-8, and 13 under 35 USC 103(a) be withdrawn.

Newly added dependent claims 15-17 further limit independent claim 1 and newly added dependent claims 18-20 further limit independent claim 8 reciting features regarding the center electrode. Newly added dependent claim 21 further limits independent claim 8 by reciting features regarding the ground electrode. Applicants respectfully submit that new claims 15-21 are allowable over the cited references.

In view of the above remarks, the present application is believed to be in condition for allowance. A prompt notice to that effect is respectfully requested. Although no additional fees are believed to be due, permission is hereby given to charge any unforeseen fees to deposit account 50-1147.

Respectfully submitted,



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